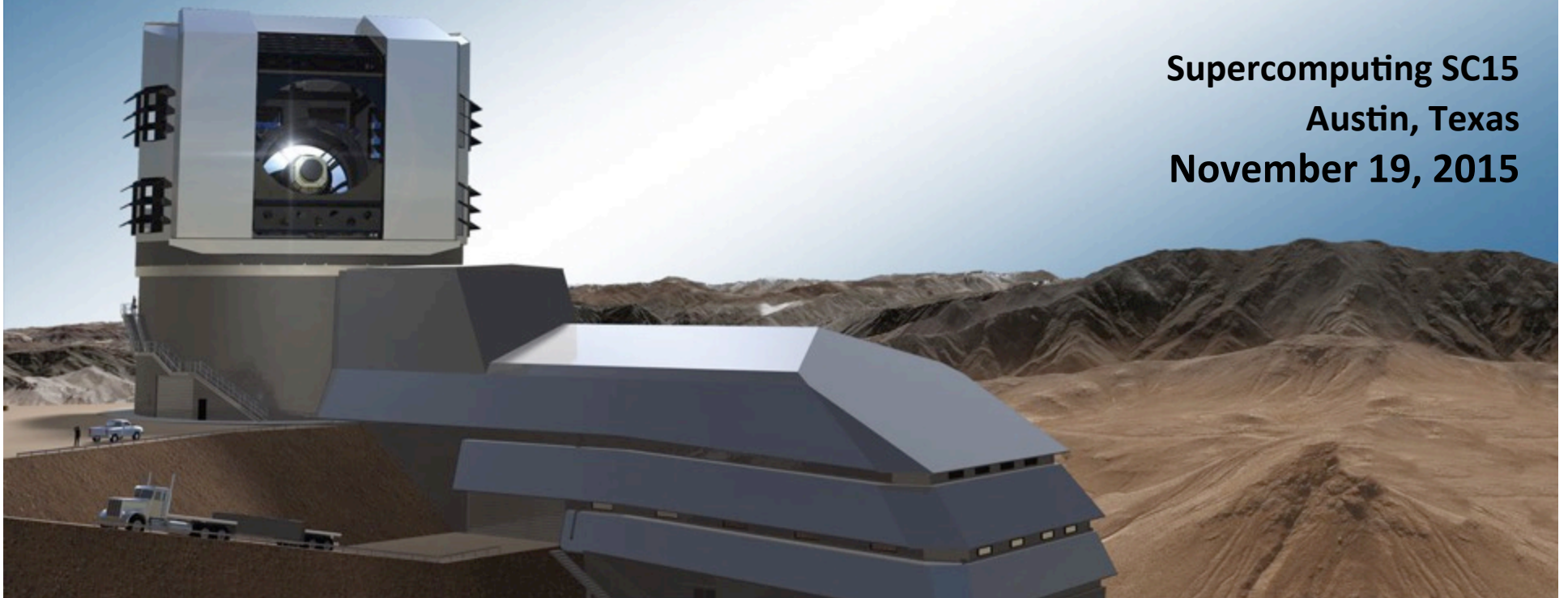


# LSST Project Update

**Heidi Morgan**  
**LSST Data Management Co-PI**  
**Florida International University**  
**Center for Internet Augmented Research & Assessment**

**Supercomputing SC15**  
**Austin, Texas**  
**November 19, 2015**



# LSST: A Deep, Wide, Fast, Optical Sky Survey



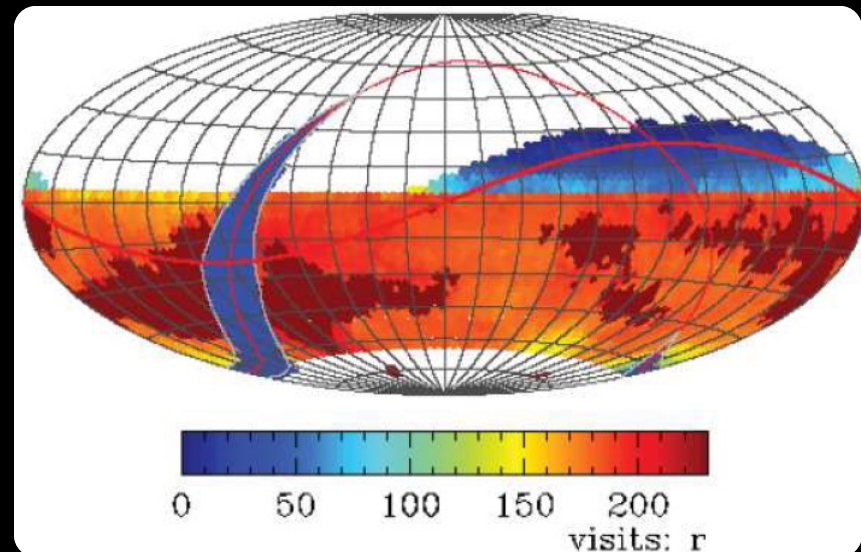
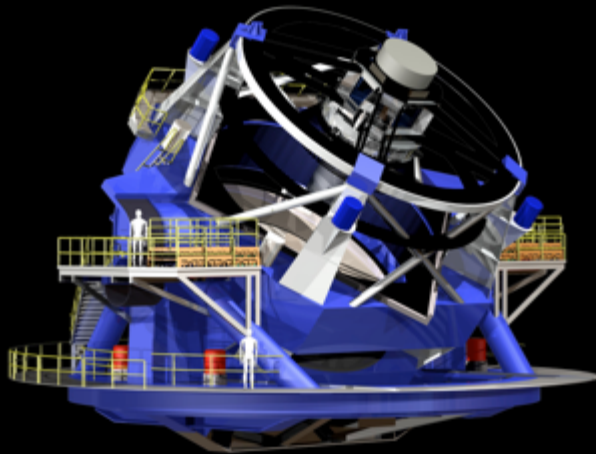
8.4m telescope

optical (ugrizy)

0.5-1% photometry (sys)

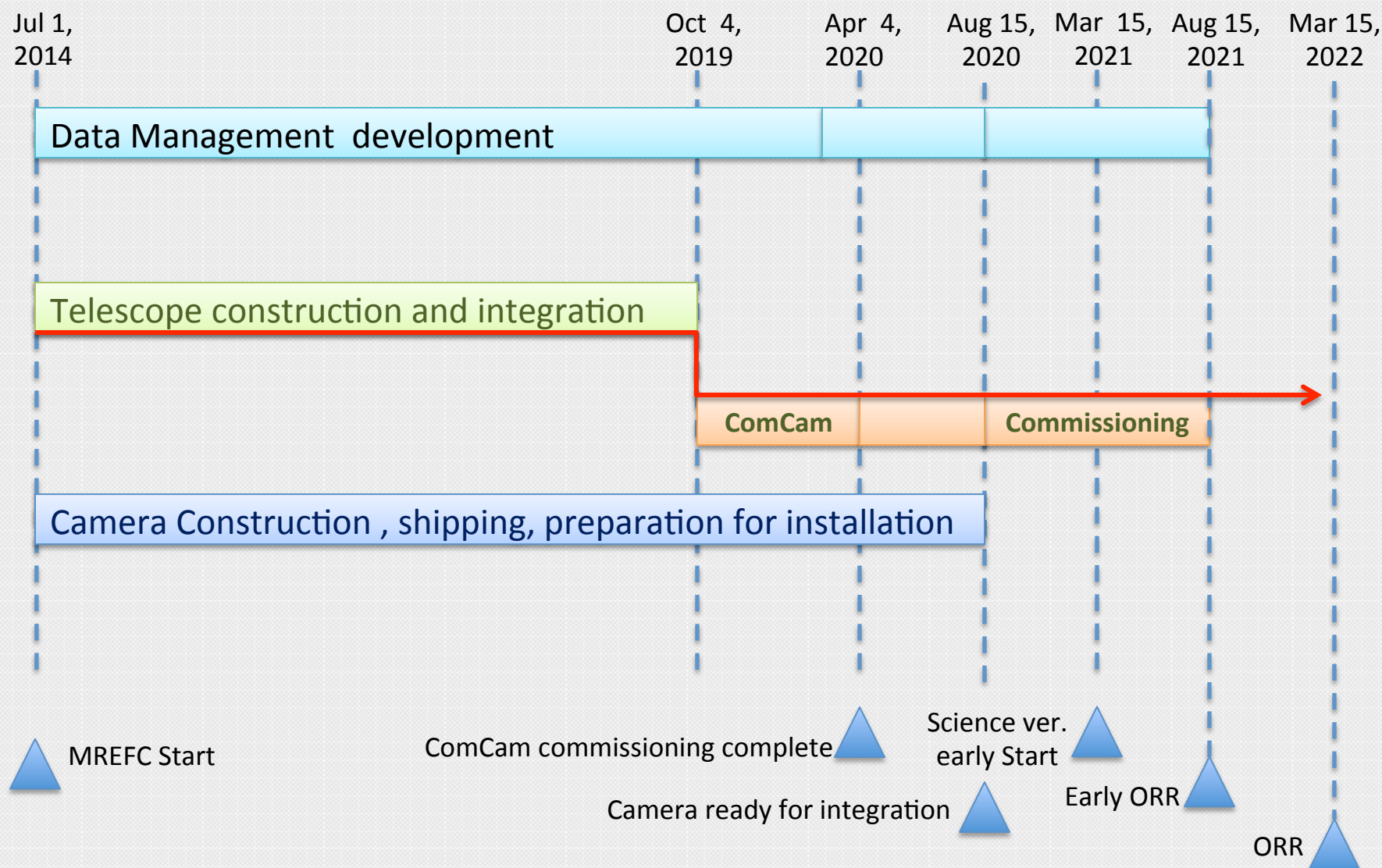
3.2Gpix camera

2 x 15sec exp / 2sec read



Location: Cerro Pachon, Chile  
Construction Start: July 2014

# Integrated Schedule key milestones





# Data Management Sites and Centers

## HQ Site HQ Facility

Observatory Management  
Science Operations  
Education and Public Outreach



## Archive Site Archive Center

Alert Production  
Data Release Production  
Calibration Products Production  
EPO Infrastructure  
Long-term Storage (copy 2)  
**Data Access Center**  
Data Access and User Services

## French Site Processing Center

Data Release Production  
(proposed)



## Summit Site Summit Facility

Telescope and Camera  
Data Acquisition  
Crosstalk Correction

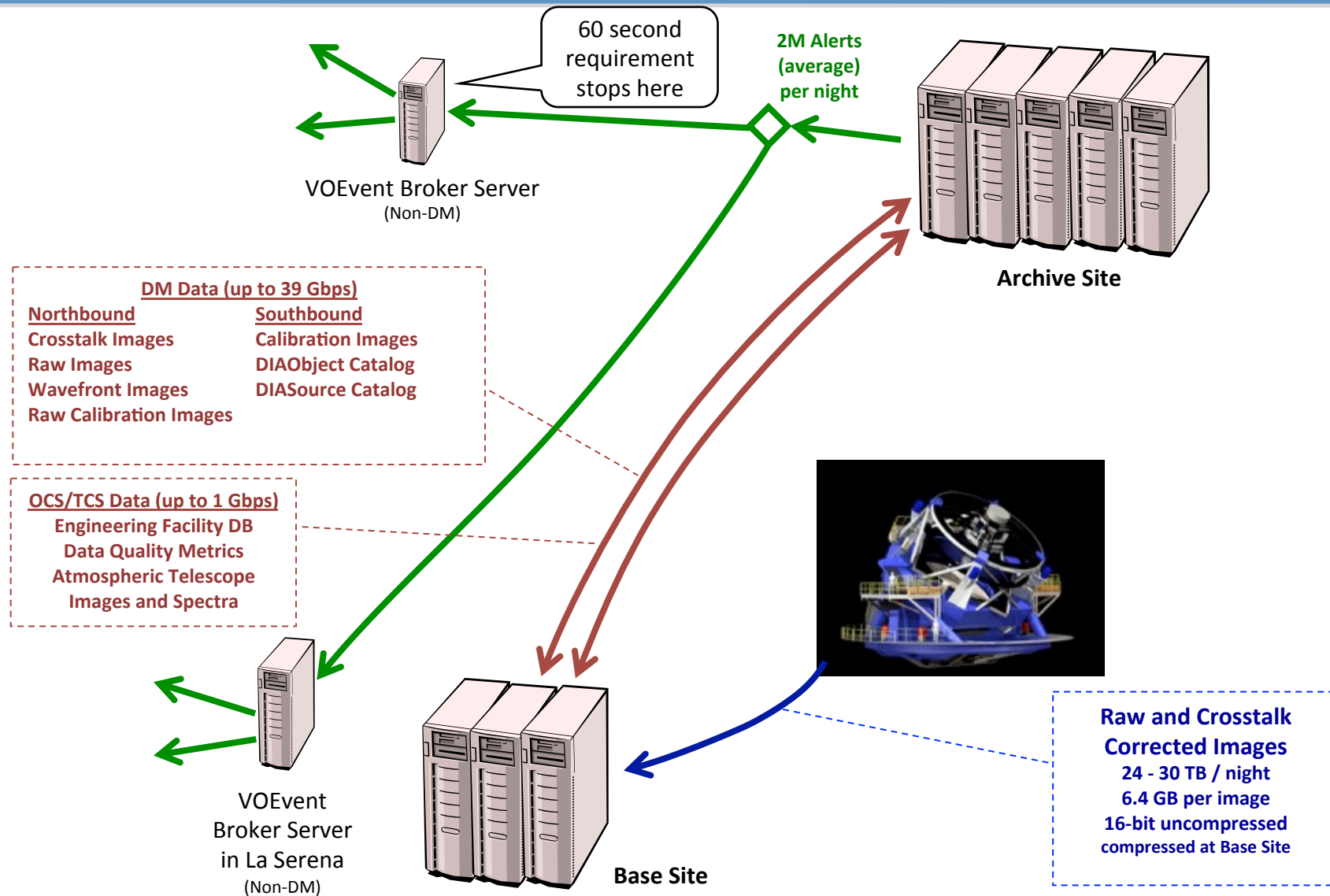


## Base Site Base Facility

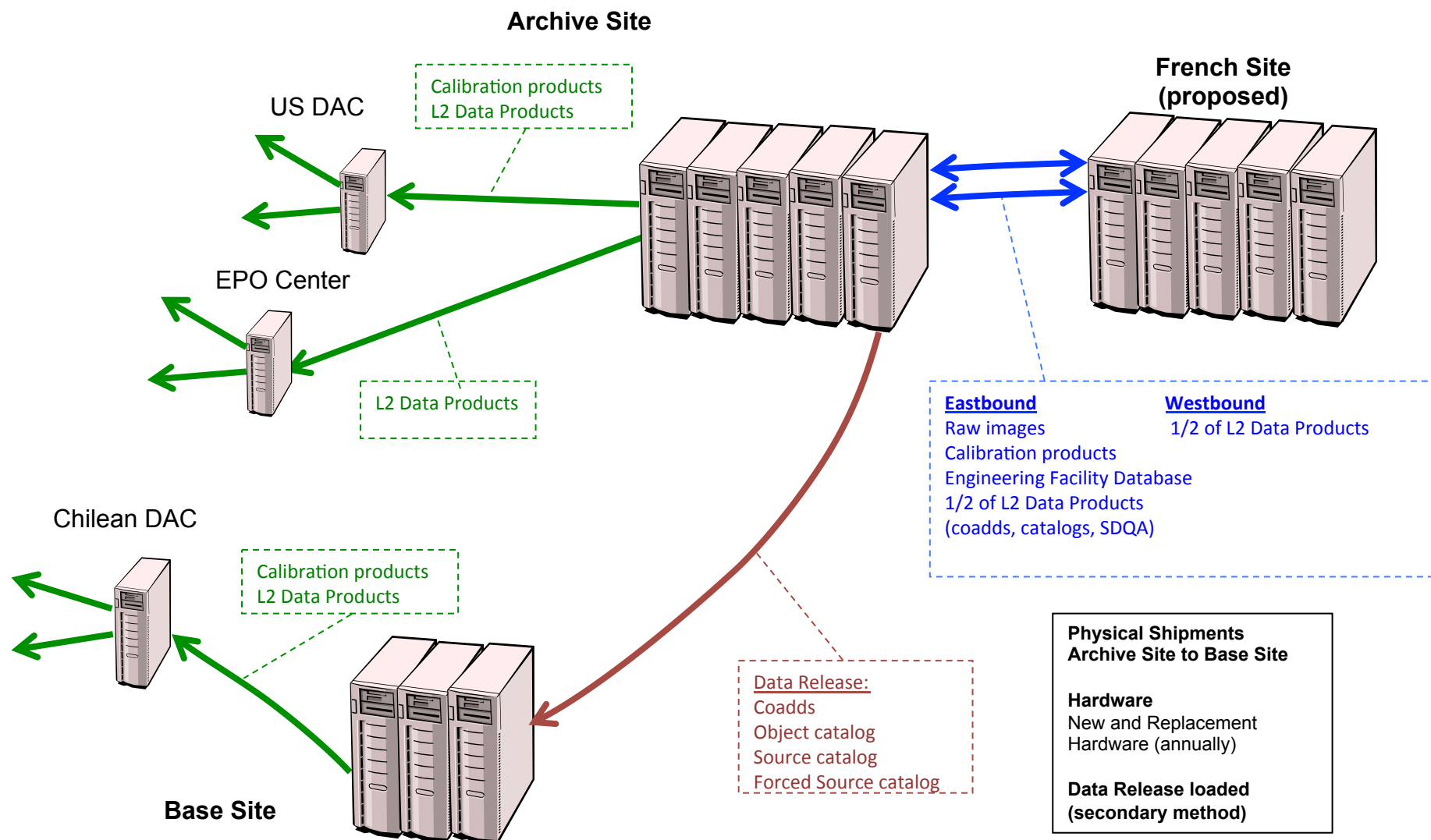
Long-term storage (copy 1)  
**Data Access Center**  
Data Access and User Services



# Nightly International Data Flows



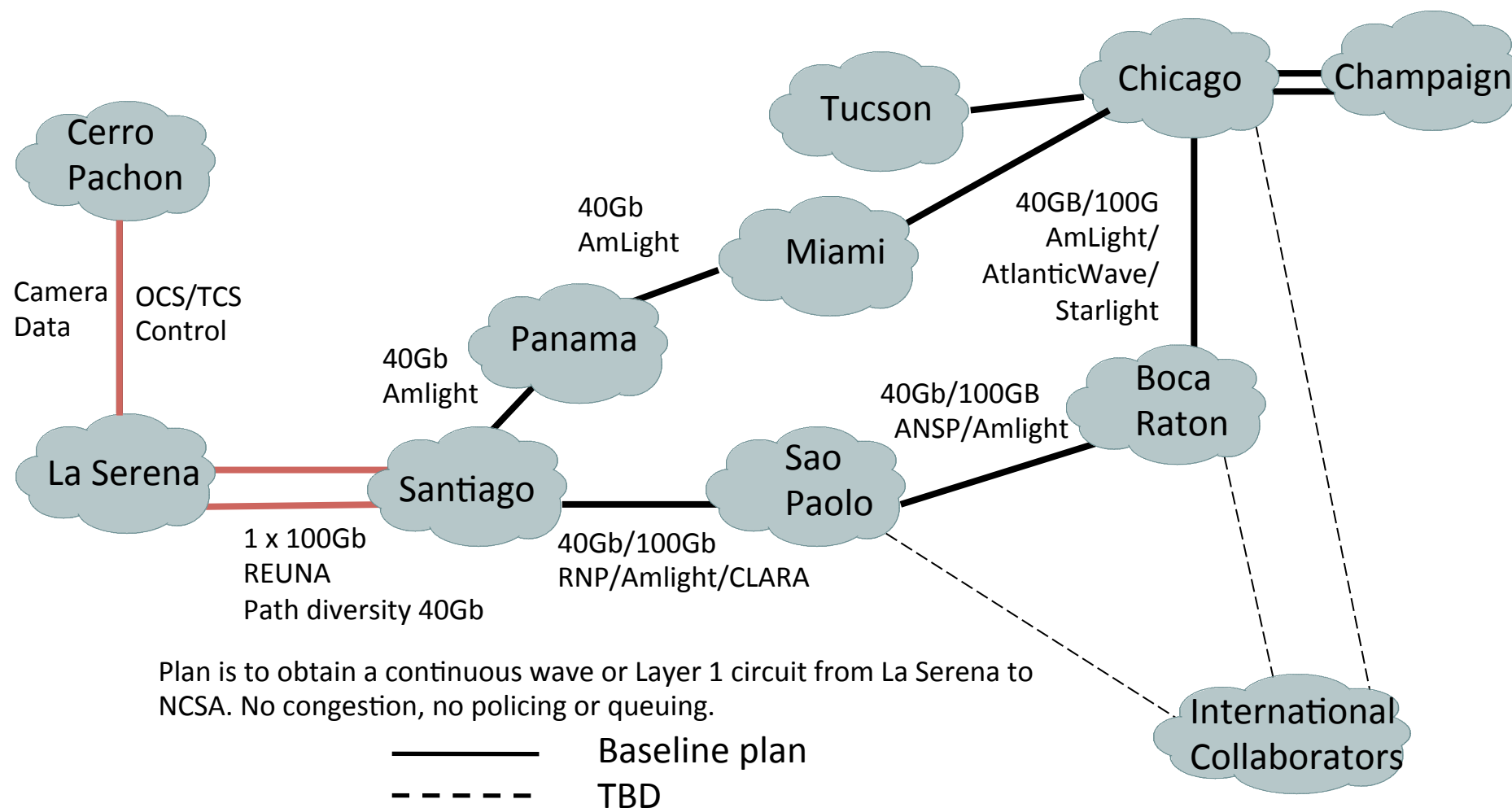
# Non-Nightly International Data Flows





# LSST Long Haul Network Links (Current Design)

2 \* 40GB/100GB  
NCSA/Iwire



# BASELINE ALLOCATION OF BANDWIDTH

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## SUMMIT TO BASE

## ALLOCATED BANDWIDTH

Crosstalk corrected images within 1 seconds	100Gb
TCS/OCS command and control	100Gb

## BETWEEN BASE AND ARCHIVE

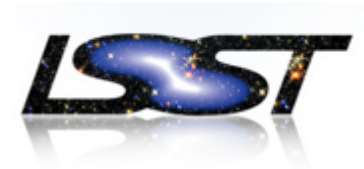
Crosstalk in 5 seconds	40Gb
Raw data 24 hours	
Data Releases once a year	40Gb
Operational traffic	10Gb

## CHILEAN OPORTUNISTIC TRAFFIC

As available



- Segment 1: “Mountain-Base” (Managed by REUNA/AURA)
  - From Cerro Pachon to La Serena computing facility, 2 x 100 Gbs (plus 100Gbps AURA shared)
  - Actually broken down into two sub-segments:
    - Summit-Gatehouse (on AURA property) = 30km
    - Gatehouse-La Serena (on public line) = 55km
- Segment 2: La Serena-Santiago (Managed by REUNA)
  - From La Serena computing facility to (TBD) connection point in Santiago with international links
  - with diverse path
  - 200Gbs best case, 100Gbs likely, 40Gbs worst case



- Segments 3 : International links
  - **Provided by Amlight/RNP/CLARA**
  - Santiago – Sao Paolo – Boca Raton east coast
    - Baseline: 40Gbps
    - Current goal: 100 Gbps link
  - Santiago – Panama – Miami west coast
    - Baseline: 40Gbps
    - Current goal: 40 Gbps link baseline
- Segment 4: US links
  - Utilizing Internet-2 and ESnet
  - at 100Gbps

## LSST MREFC Funding Status



- NSF signed Cooperative Agreement for LSST to proceed with Construction, effective July 1, 2014.
- LSST received its federal construction start August 1, 2014.
- NSF authorized the LSST project for construction with \$27.5M in FY14 and a budget plan that stays within a \$473M overall budget cap.
- Staff is ramping up across Data Management, tripling in size in FY15 – FY17
- [AURA received NSF support to manage construction of LSST; the NSF press release describes LSST construction as “taking astronomy to the next level”.](#)

## LSST First Stone, 14 April 2015



**So I am here, what can I say, so proud as President of Chile, from Cerro Pachón, in the district of Vicuña, working for the next decade of world science. With this foundation stone, today we are setting in motion the history of astronomy, the future history of astronomy.**

**President Michelle Bachelet**

## REUNA Background

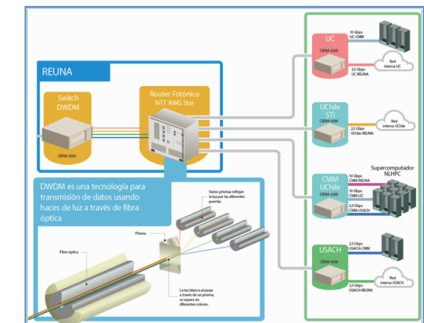
### Constructing e-infrastructure in synergy

**REUNAstm-1 backbone:** Long-term capacity over a TELCO SDH transport network. Most advanced R&E network in LA, middle of the 90's



### EVALSO

- Highlights: 1st deployment in the desert area of buried optical fiber. 1st acquisition of a long term wavelength for the national backbone.



### NLHPC

- Highlights: 1st DWDM photonic metropolitan network, deployed in Santiago. 32x32 lambdas capability.

### ALMA

- Highlights: 150Kms of fiber in the desert are, between the AOS and Calama. A wavelength from Calama to Antofagasta (REUNA node). Future redundancy path from AOS to Santiago by Argentina.

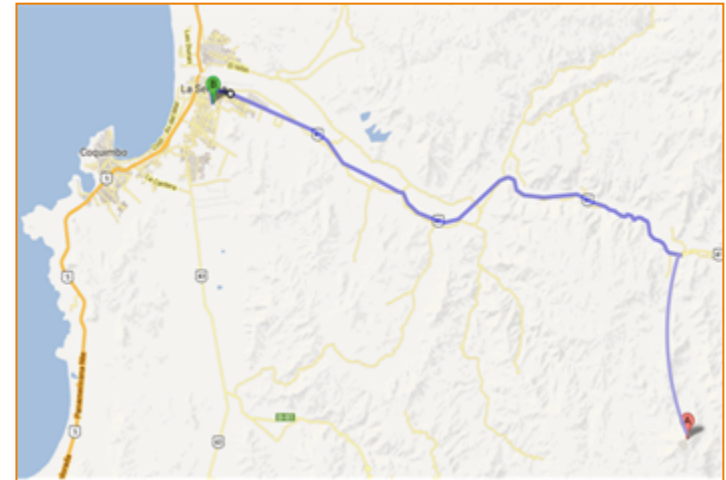




## Path inside Chile (brief)

### LSST to La Serena (LS)

- 80 Km total
  - 50 Km along the public route “ruta 41”
  - 30Kms along the AURA private land



### La Serena to Santiago

- 500 Km
- Along the main country road “ruta 5”
- Telcos lay down its fiber along “ruta 5”



### Border crossing Aguas Negras

- Is on the extension of the path from La Serena to the observatory
- Possibilities of synergy
- Redundancy path by Argentina



# AmLight.net



A screenshot of the AmLight website. The header includes the AmLight logo and navigation links: Home, About, News &amp; Events, Engineering, and Contact us, along with a search icon. The main banner shows a map of North America with the text 'RESEARCH EDUCATION COLLABORATION'. Below this, a paragraph describes AmLight's mission, followed by the AmLight and AURA logos. The 'AmLight News' section contains three items: a video player for 'LSST / AmLight', a link to a SuperComputing 2015 workshop on SDN for Scientific Networking, and a link to a workshop on High Speed Scientific Data Transfers. The bottom item mentions a SWITCH workshop in Brazil.

AmLight website: <http://amlight.net/>



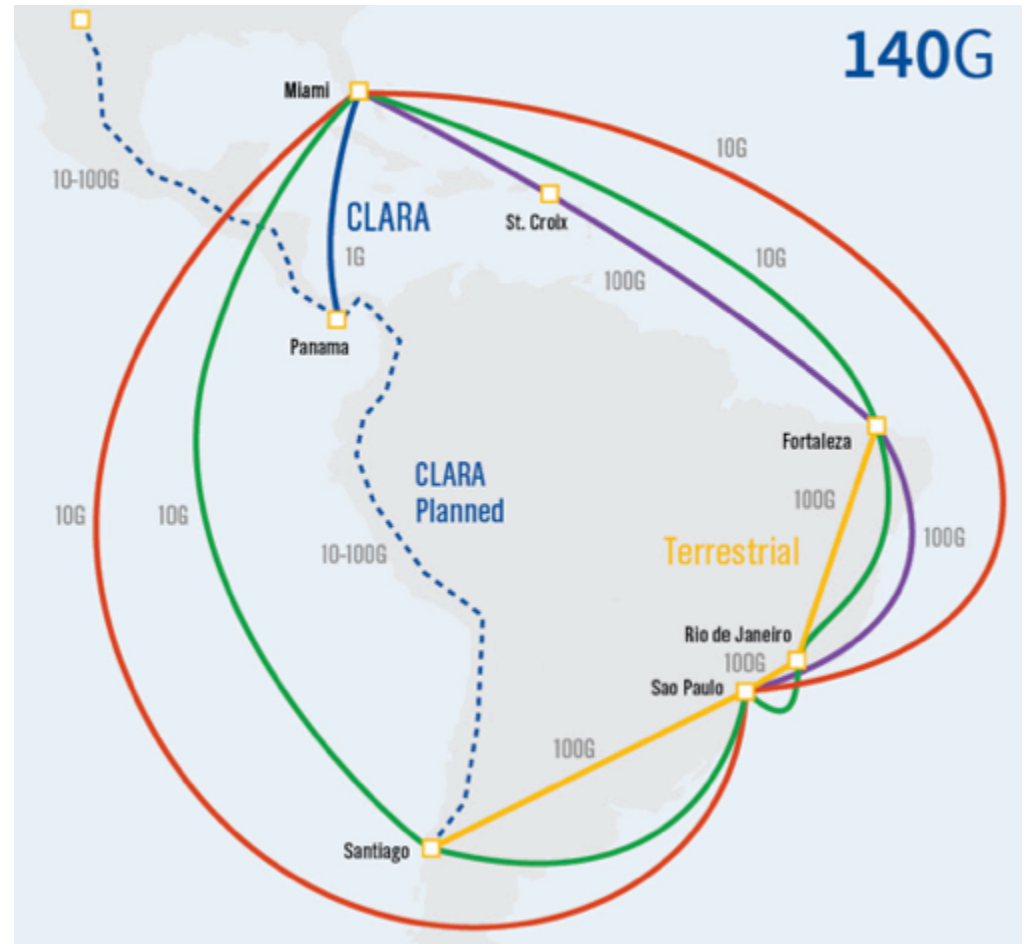
- 4 100G segments (future):
  - St. Croix (STX)-Fortaleza 4,200km
  - Fortaleza-Rio, 3,500km
  - Rio-Santos, 400km
  - Miami-STX, 2,400km
- ANSP: 2x 10G links S Paulo – Miami
  - (W) via Santiago (LAN)
  - (E) direct (Telefonica)
- RNP: 2x 10G links S Paulo – Miami
  - (W) direct (Telefonica)
  - (E) via Rio de Janeiro & Fortaleza (LAN)  
(+ redundant terrestrial links)



# AmLight SDN and OpenWave

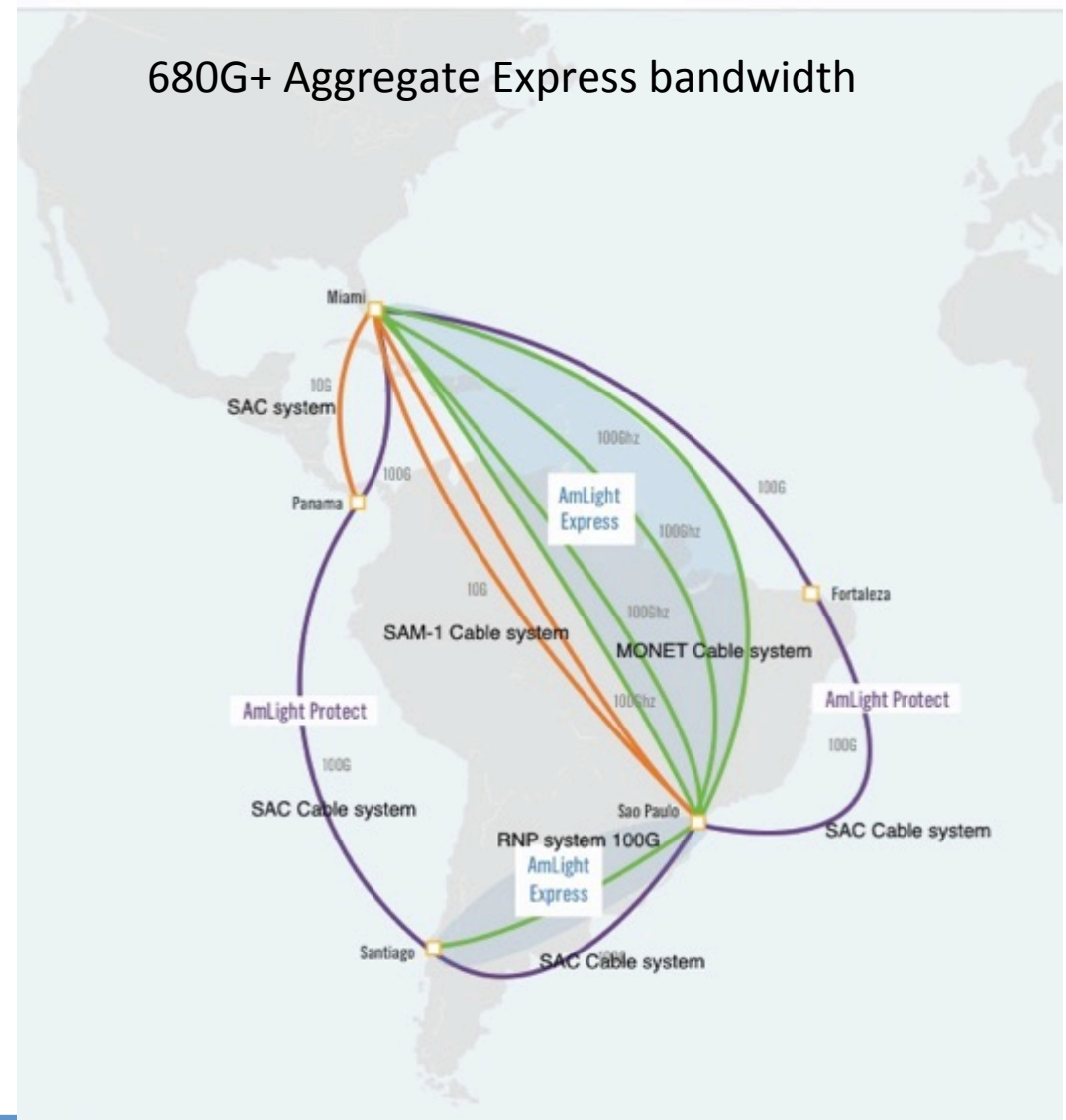


- 4 x 10G links and two topologies
  - SDN ring: Miami-São Paulo-Chile-Miami
    - 20 Gbps of total capacity
    - Full OpenFlow and network virtualization support
  - MPLS ring: Miami-São Paulo-Miami
    - 20 Gbps of total capacity
    - Layer 2 support
- OpenWave 100 Gbps between São Paulo and Miami
  - Part of the SDN domain
  - Focused on experimentation
- 140 Gbps aggregate capacity expected by June
- 100G to AL2S from Miami



## AmLight Express and Protect (ExP) - 2018

- AmLight Express (green):
  - 400GHz of spectrum: Miami-São Paulo
  - Spectrum to be configurable by RENs to meet user/application requirements
  - DWDM São Paulo-Santiago
- AmLight Protect (purple, orange):
  - 100G leased capacity ring
  - 10G segments
  - Miami, São Paulo, Santiago, Panama City, Miami
  - AMPATH, Southern Light, REUNA, and RedCLARA operated
- Multiple submarine cables for protection and high availability
- Potential for unprecedented regional resilience for U.S.-Latin America, and U.S.-Europe connectivity, supporting global science research



## Thank You & Acknowledgements

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- LSST Slides Courtesy of Jeff Kantor, LSST Data Products Manager SAACC Meeting April 2015
- Chilean Infrastructure Slides Courtesy of REUNA
- OpenWave, AmLight, OSDC-PIRE, CC-NIE, AMPATH, AtlanticWave infrastructure, science application support, education, outreach and community building efforts are made possible by funding and support from:
  - National Science Foundation (NSF) awards #AST-1202910, #ACI-1451018, #ACI-1451024, #ACI-1440728, #CNS-1443285
  - FAPESP, ANSP – grant no. 2008/52885-8
  - Rede Nacional de Ensino e Pesquisa (RNP)
  - Florida International University
  - Latin American Research and Education community